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Protected Superconducting Circuit Derived from the Fluxonium Molecule

Quantum information encoded in logical states with disjoint support and robust energies can be protected against depolarization and pure dephasing simultaneously. One promising candidate to realize such protection is the (soft) zero- π qubit [1, 2]. Here, we propose a new flavor of protected qubit derived from the fluxonium molecule [3]. Within the protected subspace, the logical states exhibit disjoint support and first-order insensitivity to flux noise. Moreover, it addresses several of the main challenges facing the zero- π qubit, featuring exponentially suppressed photon shot noise and no need for charge biasing.

[1] P. Brooks, A. Kitaev, and J. Preskill, *Phys. Rev. A* 87, 052306 (2013).

[2] A. Gyenis, P.S. Mundada, A. Di Paolo, et al., *PRX Quantum* 2, 010339 (2021).

[3] A. Kou, W.C. Smith, U. Vool, et al., *Phys. Rev. X* 7, 031037 (2017).